Technologies Development for Environmental Restoration and Waste Management: International University & Research Institution and Industry Partnerships

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INTRODUCTION

The Institute for Central and Eastern European Cooperative Environmental Research (ICEECER) at Florida State University was formed in 1990 soon after the end of the Cold War. The ICEECER consists of a number of joint centers which link Florida State University, and U.S. as well as international funding agencies, to academic and research institutions in Hungary, Poland, the Czech Republic, Russia and the other countries of Central and Eastern Europe and the Newly Independent States (NIS). Each of these joint centers is administered by an Associate Director both at Florida State University and at the participating institutions in the region. Currently, the participating institutions include: The Technical University of Budapest (Budapest, Hungary), The Czech Technical University in Prague (Prague, Czech Republic), The Technical University of Wroclaw (Wroclaw, Poland), and The Institute for Ecology of Industrial Areas (Katowice, Poland).

These formal relationships allow joint activities to be conducted which result in multi-lateral benefits to the United States and to the participating countries through the ICEECER. Areas of interest include: risk assessment; toxicology; contaminated site remediation; contaminated site characterization; waste management; emergency response; environmental technology development, demonstration and transfer; and some specialized areas of research (e.g., advanced chemical separations technology development and demonstration). Through the ICEECER, numerous international conferences, symposia, training courses and workshops have also been conducted on a variety of environmental topics.

This paper will summarize the mission, structure and administration of the ICEECER and will provide information on the many and varied projects conducted through this international, university-based partnership program at Florida State University. While an emphasis of this DOE-sponsored conference is on evaluating and forming industry partnerships for conducting environmental research, the activities of the ICEECER in Central and Eastern Europe extend heavily into environmental technology development, demonstration and exchange using laboratory experimentation, field demonstrations, and other approaches for addressing environmental restoration and waste management needs worldwide.

Contract Information

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Funding sources for the ICEECER include the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Defense - USAF, NATO, DuPont Company, the Australian Government, the Hungarian Ministry for the Environment and other international agencies and organizations. Examples of funded projects include advanced radiochemistry research in conjunction with the Czech Technical University in Prague; sensor and remote-sensing equipment development with the Technical University of Budapest; site characterization and remediation technology demonstrations in Poland with the DOE and the Institute for Ecology of Industrial Areas; containment technology demonstrations (scheduled for FY97) with the DOE, EPA, DuPont Company and the USAF; risk assessment and toxicology training in Hungary and Poland; and topical issues for NATO (development of remediation strategies for environmental contamination problems at former Soviet military bases in Central and Eastern Europe). In addition, the ICEECER conducts numerous international conferences, symposia and high-level meetings which have as principal objectives: the exchange of technical information, technology demonstration and exhibition, facilitating commercial interactions among U.S. and non-U.S. environmental businesses, and the formation of technical and commercial international partnerships for technology development and application.

OBJECTIVES

Florida State University utilizes its experience and knowledge base derived from on-going activities to expand its program of international environmental technology identification, development, demonstration, exchange and associated research that will support the nation's environmental clean-up efforts by increasing the quantity and quality of technical information which can be used for cleaning-up contaminated sites. The ICEECER not only utilizes the academic resources of Florida State University, but also those of other appropriate academic institutions, the national laboratories, and both nationally-renown and internationally-renown experts as needed to conduct the activities for this cooperative agreement.

Work activities focus on the investigation of environmental technologies under development to determine applicability to various public environmental clean-up situations in the context of whether these technologies are faster, better, safer, and/or less-costly than existing technologies in-use at contaminated sites and for waste management. Site characterization technologies, monitoring technologies and restoration technologies are also investigated to determine cost-effective approaches for site clean-up activities. Processes are being developed to facilitate the joint involvement of the stakeholders and the regulatory community in the processes used for determining cost-effective research and development projects.

The technologies investigated by the ICEECER include not only those in the U.S. but also technologies being developed abroad for site restoration and waste management (e.g., in the Czech Republic, Hungary, Poland and Russia). The focus of these investigations are on enhancing the technology transfer, both import and export, of innovative and emerging technologies dealing with site characterization, containment, site remediation, monitoring, waste management and the environmental aspects of energy production. The innovative technologies include long-term, cost-effective monitoring methods applicable in areas undergoing clean-up and restoration. As appropriate, these technologies will be evaluated for transfer to similar sites in the United States.

Work is focused on assisting in the identification and evaluation of innovative technologies which are being developed by foreign scientists. The Florida State University both conducts and participates in symposia, conferences, workshops and other high-level meetings (e.g., NATO, IAEA) which serve as vehicles for identifying and evaluating these innovative environmental technologies

One of the critical objectives of this program is to address problems at federal and other publicly-owned facilities where contamination of the environment is of concern. The focused effort at Florida State University and associated project results will be integrated into remediation efforts at other sites which have comparable environmental problems. Through this process, research on these technologies can support remediation and waste management clean-up activities throughout the United States. Such feedback can be effectively utilized in the development of new technologies, prioritization of restoration efforts, communication with the public, and acceleration of contaminated site clean-up to protect human health and the environment. The Florida State University has personnel and resources which will provide for the efficient conduct of the above activities and which provide for the appropriate financial management of these cooperative agreement activities. Further, the faculty and facilities of the ICEECER are flexible enough to re-structure effort and emphasis as is required and which reflect experience gained in managing these proposed activities.

APPROACH

The approach taken to attain the objects of this joint DOE/Florida State University initiative is to utilize a combination of projects to address the needs of international environmental technology identification, development, demonstration, exchange and associated research for the DOE. These projects involve laboratory research, field investigations, technology demonstrations, technical exchanges of scientists from Central and Eastern Europe and Russia and from the United States. This approach is described in the context of the projects for this cooperative agreement. Selected major projects are described in the following section (Project Descriptions).

PROJECT DESCRIPTIONS

Environmental Research in Russia

The technical/experimental international activities of the ICEECER will be presented as examples of projects conducted typically in conjunction with partnership institutions in Central and Eastern Europe and Russia.

The program in Russia is one that has been in operation for approximately three years through the DOE - EM-50. Dr. Thomas Albert (Thomas E. Albert and Associates, Inc.) is chiefly responsible for coordinating the research activities of this program under sub-contract to Florida State University. As examples of activities under the Russian Program, a total of 17 new FY96 projects were authorized for funding at Russian institutions in early February of 1996. These 17 new projects, conducted by Russian research institutions, are the following:

- Experimental Research Program on Self Cleaning of the Mishelak River ($60K research budget)
- Experimental Research Program on Multi-Packer Well Tests ($100 budget)
- Experimental Research Program on Mayak Contaminant Transport Modeling ($40K research budget)
- Experimental Research Program on Tomsk Contaminant Transport Modeling ($20K research budget)
- Biotechnological Decontamination of Open Ponds Contaminated with LLW ($10K research budget)
- Use of Supercritical Fluid Extraction for Transplutonium Element Decontamination of Solid Materials ($10K research budget)
- Cryogenic Technology and Development Equipment for Production of Granulated Materials ($10K research budget)
- Applicability of the Russian Separations Technology to Processing of US Radioactive Wastes ($200K research budget)
- Recovery of ^{137}Cs from Actual INEL High Level Waste by Sorption Technique with Copper Ferrocyanide ($15K research budget)
- Investigation on Removal of TRU from Alkaline Solutions on Carriers Obtained by the Method of Appearing Reagents ($30K research budget)
- Investigation on Disproportion of Plutonium(V) in Alkaline Media of Various Composition in Liquids and Model Sludges ($30K research budget)
- Investigation on Isolation of Technetium from Alkaline Solutions ($30K research budget)
- Investigation on Application of Homogeneous and Heterogeneous Catalysis from Alkaline Treatment ($30K research budget)
- Evaluation of Russian Liquid-Liquid Extraction Technologies Using Crown Ethers (CE) for Decontamination of Low and High Level Radioactive Wastes from Long-Lived Radionuclides and Toxic Metals ($50K research budget)
- Assessment of Russian Waste Treatment Technologies and Applicability to US DOE Mixed Waste Focus Area Needs ($20K research budget)
- Experimental Investigation of Radionuclide Partitioning in a High frequency Induction Melter ($50K research budget)
- Pilot-Scale Apparatus for Treatment of Solid Mixed Radioactive Wastes: Plasmatron with Induction Cold Crucible Melter (PICCM) ($71K research budget)

The total budget for all 17 FY96 Russian projects is $771,000 to be conducted throughout fiscal year 1996.

Advanced Chemical Separations (Ion-Exchange) Research in the Czech Republic

Dr. Ferdinand Sebesta (et al.) of the Faculty of Nuclear Sciences and Physical Engineering at the Czech Technical University in Prague is conducting experiments on the chemical and radiation stability of the specialized ion-exchange polymer materials developed at the CTU. In

FY96, a project "Evaluation of Polyacrylonitrile (PAN) as a Binding Polymer for Absorbers Used to Treat Liquid Radioactive Wastes" was conducted at the Czech Technical University in Prague as a project supported by the Efficient Separations and Processing Crosscutting Program (ESP) of the U.S. Department of Energy's EM-50. The main and most important result of this project is that polyacrylonitrile (PAN) is being shown to be a versatile polymer capable of forming porous composite absorbers with small particles of a large number of primary absorbers. The composite absorbers are proving to be capable of withstanding harsh acidic and alkaline conditions and significant radiation doses that may be encountered in the treatment of DOE liquid radioactive wastes.

In acidic solutions, the results of the study of the chemical stability of PAN in the form of macroporous beads (B-PAN) similar to the beads of composite absorbers revealed their excellent chemical stability for a period of one month of contact with 1M HNO_3 + 1M $NaNO_3$. Chemical stability of AMP-PAN composite absorber (ammonium phosphomolybdate active component in PAN binder) was found to be as good as that of B-PAN beads. In highly alkaline solutions (concentration of NaOH 1 mole.L^{-1}) and in the presence of $NaNO_3$ the stability of the tested type of polyacrylonitrile polymer was sufficient for applications of composite absorber not exceeding 10 days. The experimental results achieved proved that the hydrolysis of PAN is accelerated by the presence of sodium nitrate. The study of influence of concentration of sodium hydroxide on the chemical stability of the binder revealed that in 0.1M NaOH + 1M $NaNO_3$, PAN is stable for the tested period of 1 month. Because of the high sorption rate achievable with these absorbers, the stability found for most applications in the U.S. will be sufficient.

Radiation stability of the PAN binder was found to be satisfactory up to radiation doses of 10^6 Gy (10^8 Rad) for all the media tested (distilled water, 1M HNO_3 + 1M $NaNO_3$, 1M NaOH, and 1M NaOH + 1M $NaNO_3$). In alkaline simulant solutions, clear positive influence of g-radiation on the stability of PAN in alkaline media could be seen. This effect, that was ascribed to PAN polymer cross-linking during irradiation, enables additional prolongation of the period of applicability of PAN-based composite absorbers. Further, improving the chemical stability of the binding polymer was suggested to be achievable by selecting another type of polymer from the broad family of polyacrylonitrile polymers. Results of the FY96 experiments are reported in "Evaluation of PAN-Based Inorganic-Organic Composite Absorbers for Chemical Separations Applications at DOE Sites" (Ferdinand Sebesta, Jan John, Alois Motl - June 1996).

These experimental results and potential application within the U.S. have resulted in a technology demonstration at INEL using actual DOE waste to be co-directed by Dr. Sebesta (CTU) and Dr. Terry Todd (INEL). This demonstration will involve the use of columns through which radioactive waters will be pumped to determine the effectiveness and selectivity of the PAN-based ion exchange materials using actual waste. This technology demonstration is scheduled for early FY97.

Containment Technology Research

A large containment technology demonstration project, jointly sponsored as a public/ private partnership project, will be conducted at the national Groundwater Remediation Field Laboratory (GRFL) at Dover Air Force Base (Dover, Delaware). This project will evaluate the effectiveness of high pressure, thin-walled diaphragm containment walls and "cofferdam" configured

containment systems. Co-sponsors of this project include the DOE, EPA, DuPont Company and the USAF. This project will be conducted principally during FY 97. This is a two-phase project involving a test panel phase (Phase I) which will include emplacement of the panels, verification monitoring, coring of the walls to evaluate emplacement effectiveness and lab testing of the wall cores. Phase II activities ("cofferdam phase") will involve emplacement of a cofferdam box configuration to test the effectiveness of a thin-walled, diaphragm containment system based on the results of Phase I activities. Phase II activities will commence in the spring of 1997 and conclude in August-September of 1997.

Site Characterization and Remediation Technology Demonstrations in Poland

The ICEECER, in conjunction with the U.S. DOE and the Institute for Ecology of Industrial Areas (Polish acronym: IETU) located in Katowice, Poland is conducting a large technology demonstration project at an old (100-years old), active oil refinery site near to Katowice, Poland. The Katowice region is part of the "Sulfur Triangle" which includes portions of the Czech Republic, (former) east Germany and southern Poland. This area is endowed with significant deposits of high-sulfur brown coal (lignite) and as a result of former Soviet manufacturing interests, this region also became a major industrialized area. After nearly 4 decades of intense industrial activity (fueled with this high sulfur coal), the area has become heavily contaminated both from atmospheric deposition as well as the more typical forms of environmental contamination, involving a variety of chemicals and heavy metals. The IETU has historically been a major source of technical input to the Polish government on environmental and energy related matters and recently was designated the "premier" environmental research institution in Central and Eastern Europe (CEE). Given its significant, indigenous environmental problems, its long history of environmental research and the technical capability of its senior scientific staff, the IETU was chosen as a Central European "partner" for this project.

A three-phase project is being implemented to demonstrate the DOE's expedited site characterization (Phase I) methodology, risk assessment procedures for determining a site remediation approach (Phase II), and technologies for site remediation in southern Poland (Phase III). The ICEECER provides overall management and coordination for this project. The ICEECER was responsible for completion of the project work plan, coordination with the other "project team members" (i.e., DOE-EM, Westinghouse Savannah River Company, Ames Laboratory, SAIC, GETF, IETU, Czechowice Oil Refinery), implementation of all sub-contracts necessary to support vendors of U.S. technologies for Phase I demonstration and to support the IETU during Year 1 of this project. Phase I and Phase II have been completed (during FY96) and Phase III was initiated during FY96 and will be completed during FY97.

An important aspect of Phase I activities was a "Visitor's Day" which was conducted on May 27, 1996 at the site (Czechowice Oil Refinery site near to Katowice). During this day, each of the 5 primary technology vendors were required to demonstrate their U.S.-developed technologies at the Czechowice Oil Refinery Site. It should be noted that some of the vendors of these U.S.

technologies have offices in Europe which minimized the costs associated with the technology demonstrations. The primary U.S. technologies demonstrated were the following:

- Cone Penetrometer (truck) with LIF/ROST sampling capability (vendor: UWG GmbH - Breslau, (former east) Germany)

- Geoprobe sampling (truck) (vendor: Mayfair - Poland - a U.S.-Houston, Texas-based company in Warsaw)

- Ground penetrating radar and EM resonance evaluation for non-intrusive evaluations of sub-surface, including evaluations for unexploded ordnance (this area of Poland was heavily bombed during WWII and the refinery is over 100 years old) (vendor: Parsons Environmental Sciences - United States)

- Non-vertical, directional drilling and sample collection (vendor: Entreprenad - Malmo, Sweden - a DitchWitch distributor)

- Hydrocarbon fluorosensor field analytical sampling (vendor: Technical University of Budapest in conjunction with Florida State University)

In addition to these primary technology demonstrations, an entire suite of low-cost, simple and rapidly responding technologies were demonstrated during Phase I of this project, including the following:

- Passive soil gas survey

- Immunoassay analytical analysis

- Stratigraphic characterization

- Active soil gas analysis

- Data visualization and analysis (using Earth Vision 3-D software)

For "Visitors Day", there were over 300 visitors who toured the site from all over Central and Eastern Europe and the United States to view these technologies "at work". In addition, there were 40 members of the press who documented the activities of this DOE technology demonstration in southern Poland.

Conferences, Symposia and High-Level Meetings to Facilitate International Technical Exchange

The ICEECER has conducted numerous large international conferences and symposia both in the U.S. as well as in Central Europe. Examples of these activities include the First, Second and Third International Symposia and Exhibitions on Environmental Contamination in Central and

Eastern Europe (i.e., Budapest '92, Budapest '94 and Warsaw '96, respectively), the International Symposium and Trade Fair on the Clean-up of Manufactured Gas Plants (Prague, September of 1995) and the 1997 International Containment Technology Conference and Exhibition (St. Petersburg, Florida, February 9-12, 1997). These large international events have all been sponsored by the EPA, the DOE and other public and private organizations. Each of these week-long international events has included participation by approximately 500 international environmental experts who have participated in 20+ technical sessions per event, poster sessions, workshops and special topical sessions (e.g., health effects from exposures to environmental contaminants in Central and Eastern Europe, identifying sources of financing for environmental projects in Central and Eastern Europe), exhibitions and trade shows.

An important aspect of these international events was to facilitate commercial interactions among the symposium delegates. These commercial interactions were supported through exhibitions, use of Business Centers, the participation of the U.S. Commercial Service, and through special sessions on identifying sources of financing for environmental projects. The Business Centers consisted of a room that is made available to exhibitors and other U.S. businesses for conducting meeting outside of the exhibition area. These centers are typically used constantly throughout these events on a reservation basis. The delegates are provided the schedule of which businesses will be in the Center at scheduled times so that appointments could be made through the symposium registration staff. The U.S. Commercial Service is also provided a booth and personnel are made available to discuss how the U.S. Commercial Service can be of assistance to U.S. companies outside of the United States.

In addition, annual high-level meetings are facilitated by the ICEECER involving the NATO/CCMS Program as it relates to contaminated land and groundwater. The Council of the North Atlantic Treaty Organization (NATO) established the Committee on the Challenges of Modern Society (CCMS) in 1969. The CCMS was charged with developing meaningful environmental and social programs which complement other international programs with leadership in solving specific problems of the human environment within the NATO sphere of influence; as well as transferring solutions to other countries with similar challenges in environmental protection.

Over the past thirteen years, this issue, the treatment of contaminated land and groundwater, has been addressed by three NATO/CCMS Pilot Studies. This third Pilot Study, initiated in 1992, focuses on evaluation of demonstrated and emerging technologies for the treatment of contaminated land and groundwater (both chemical and radioactive contaminants as well as mixed waste). Through these Pilot Studies, critical technical information has been made available to participating and other countries. The EPA and the DOE have been active participants in this NATO Pilot Study entitled, "Evaluation of Demonstrated and Emerging Technologies for the Treatment of Contaminated Land and Groundwater". All of the NATO countries and many non-NATO participating countries participate in the Pilot Study activities which serve to effectively disseminate information on technologies in-use worldwide related to contaminated land and groundwater.

Because of the relevance of this NATO activity to the mission of the ICEECER, this Pilot Study has been planned and organized by Florida State University as an adjunct activity to its funded activities at the ICEECER. Florida State University has assisted with the organization of these international meetings for the last five years and will continue to do so throughout the year 2002. This Pilot Study is particularly important to the activities of the ICEECER as it provides ready access to a network of high-ranking agency officials (and associated support contractors) throughout most of Europe and many other parts of the world. Many of the Pilot Study members participate in the other non-NATO related activities of the ICEECER and are also very effective in disseminating information about the work of the institute within their respective countries.

RESULTS AND BENEFITS

The purpose of this paper is to demonstrate, through the use of examples, the effectiveness of international environmental technology development and demonstration through international university and research institution-based initiatives. The ICEECER provides an effective conduit for accessing technical environmental expertise in a region of the world heretofore almost inaccessible prior to the end of the Cold War. During the last five years the ICEECER has moved quickly, using a variety of activities to facilitate the establishment of countless technical relationships and commercial linkages between western countries and the countries of Central and Eastern Europe. Through direct research and development programs in Hungary, Poland, Czech Republic and Russia, the ICEECER has been able to provide multi-lateral benefits to U.S. funding agencies, research institutions in Central and Eastern Europe and to commercial interests worldwide interested in the growing environmental markets in Central and Eastern Europe. Though still in its formative years, the ICEECER at Florida State University intends to build upon these opportunities through expanded research programs and through the implementation of broad-based activities which address environmental problems in Central and Eastern Europe - problems which are also common to the rest of the developed world.

The opportunities in this region of the world for environmental technology development and demonstration are significant. Research scientists from this region of the world are highly training and skillful individuals having technical, laboratory skills on a parity with the rest of the world. In addition, many scientists in the region have had relatively more extensive experience with specific problems as compared to U.S. scientists (e.g., chemical separations technologies for removing radionuclides from water, vitrification technologies for radioactive waste management). The cost of highly-skilled labor for conducting research projects in Central and Eastern Europe is typically much less than if the same projects were conducted in the United States or Western Europe and, for this reason, the incentive to engage scientists from Central or Eastern European countries as well as from Russia can be significant, especially in the areas where these scientists have a relative advantage scientifically.

Certain industrial areas of Central and Easter Europe have very extreme forms of environmental degradation (e.g., the “black triangle” area of southern Poland, northern Czech Republic and former east Germany) have very severe environmental problems. These problems exist because of the abundance of high-sulfur brown coal (lignite) and associated concentration of

industry over the last 40-50 years and, finally, the near absence of environmental protection during Soviet occupation. This region of Central and Eastern Europe, for example, represents an unusual setting that does not generally exist in the United States or Western Europe with regard to human exposure to contaminants, soil and groundwater concentrations of certain environmental contaminants, and a willingness to have environmental technologies demonstrated at sites with these extreme environmental conditions. As evidenced by the technology demonstration project conducted in Katowice, Poland, the ability to implement this demonstration project in relatively short order (6 months) in the central area of a municipality and within full view of residences would have been very difficult if not impossible in the United States. The ability to demonstrate technologies quickly and under these unusual environmental conditions should be viewed as a positive reason for interacting with Central and Eastern European governments for this purpose. Beyond the unique perspectives gained by U.S. government agencies related to these international partnerships, multi-lateral benefits flow to the countries of Central and Eastern Europe in the form of environmental expertise (technology transfer), project management expertise, support for scientists and environmental researchers in this region of the world, enhanced business opportunities for in-country environmental firms that partner with U.S. companies to seek joint projects, and the transferability of this expertise throughout the region. Based on these comments and experiences, it can clearly be concluded that these partnership projects generate significant multi-lateral benefits that justify U.S. participation in these international environmental projects.

CONCLUSIONS AND FUTURE ACTIVITIES

Based on the experiences gained over the last five years with the activities of the ICEECER, it is concluded that significant multi-lateral benefits can be obtained by the U.S. and participating universities and research institutions in Central and Eastern Europe and Russia related to environmental needs. These benefits result in the form of access to advanced scientific knowledge related to certain environmental problems, lower costs for conducting critical research, technology and expertise exchange (both direct and indirect through the rapid transfer of technology and project management skills throughout the region), providing direct support to scientists in Central and Eastern Europe through sponsored research projects, and access to somewhat unique environmental conditions to rapidly demonstrate technologies for shared environmental problems. It is also concluded that significant environmental technology export opportunities are made available through participation at U.S. sponsored conferences and symposia, through partnering activities with in-country environmental firms and as a result of technology demonstrations in the countries of Central and Eastern Europe.

In terms of future activities, the specific projects for budget year two of this cooperative agreement are the following:

- JCCEM Activities in Russia - continuation with research projects under the JCCEM Framework with Russian Institutions. During FY 96 17 new research projects were funded by DOE under this program - it is anticipated that significantly more funding will be allocated during FY97 for project implementation under the JCCEM Program

which is coordinated for DOE by Florida State University in conjunction with Dr. Thomas E. Albert (Thomas E. Albert and Associates, Inc.).

- Joint Research Projects with the IETU/RACE (Poland) - three main projects and one continuation project are scheduled with the IETU in Poland. The three projects involve evaluation phytoremediation as an effective method of removing selected heavy metals from soils; evaluations of binding heavy metals in soil as a means of reducing the bioavailability of these metals in the food chain; and evaluation and demonstration of innovative plant stress monitoring equipment as site characterization technology. The on-going project is Phase III of the Czechowice Oil Refinery site project implemented during FY96.

- Containment Technology Research and Demonstration - this task will involve conduct of the 1997 International Containment Technology Conference and Exhibition during February of 1997 and conduct of the High Pressure Jet Grouting technology demonstration project jointly conducted by DOE, EPA, DuPont Company and the Air Force at the national Groundwater Remediation Field Laboratory at Dover Air Force Base in Dover, Delaware.

- Chemical Separations Research in the Czech Republic - this task will involve the conduct of a demonstration of the PAN-Based Ion-Exchange Technology developed at the Czech Technical University in Prague at INEL.

- International Environmental Symposia and Exhibitions - in addition to the 1997 International Containment Technology Conference and Exhibition, planning will implemented for the Fourth International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe (Fall of 1998; likely venue: Prague, Czech Republic). In addition, initial planning will be made to conduct one additional international conference addressing DOE-specific problems and needs.

- NATO/CCMS Activities - Florida State University will plan, organize and conduct the 1997 NATO/CCMS Pilot Study Annual Meeting at the Colorado School of Mines. The Pilot Study on "Evaluation of Demonstrated and Emerging Technologies for the Treatment of Contaminated Land and Groundwater" will conduct its full meeting during March of 1997 where approximately 70 environmental experts will discuss and present current information on environmental restoration and waste management information from all over the world.

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